The Bay Institute
Environmental Defense Fund
Defenders of Wildlife

December 20, 2009

Bay-Delta Conservation Plan (BDCP) Steering Committee
C/o California Resources Agency
1416 Ninth Street, 13th floor
Sacramento, CA 95814

RE: Draft Conservation Plan (Chapter 3)

Dear BDCP Steering Committee Members,

We have reviewed the July 2009 draft of Chapter 3 (Conservation Strategy) for the Bay-Delta Conservation Plan. In our view, a properly constructed plan should be based on 1) the establishment of clear overarching goals as well as quantitative and measurable objectives that define desired outcomes for covered species and the Delta ecosystem; 2) a thorough articulation of those stressors that impede attainment of the plan's desired outcomes and the hypotheses regarding potential species and ecosystem response to different approaches to reducing or eliminating stressors; and 3) the development and selection of a suite of conservation measures that are prioritized based on scientific certainty, magnitude and breadth of potential ecological benefits and adverse consequences, reversibility, time required to demonstrate results, and information richness. The current draft of Chapter 3 does not fully meet these criteria; rather, there are systemic problems that preclude the use of this draft in its current form as the foundation for a legally and scientifically defensible Habitat Conservation Plan (HCP) and Natural Communities Conservation Plan (NCCP). These comments therefore offer a broad critique of the document rather than a line-specific review and revision. To best address these deficiencies, we propose an alternative approach to developing and refining the Conservation Strategy.

OVERVIEW

In summary, the systemic problems we have identified with the Conservation Strategy include:

- Desired system and plan outcomes for the recovery and restoration of covered species and the Delta ecosystem are not sufficiently defined (and expressed as goals and objectives), making it impossible to assess the efficacy of the proposed strategy or manage its implementation adaptively.
- Existing scientific information is inadequately incorporated and/or incorrectly characterized in numerous cases, severely undermining the foundation for the proposed suite of actions.
- Projected outcomes, risks, and uncertainties of implementing conservation measures are insufficiently and/or incorrectly described, as is their contribution to alleviating hypothesized stressors, casting a high degree of doubt on the efficacy of the proposed plan.
- Adaptive management is insufficiently incorporated into the design and selection of conservation measures, undermining the plan's ability to respond robustly and credibly to new information and changing conditions.

In order to remedy these systemic problems, we recommend that the draft Strategy be thoroughly revised based on:

- The adoption of a "logic chain" approach, which links desired outcomes to hypotheses, projected outcomes, and performance assessment.
- The prioritization of conservation measures according to scientific certainty, magnitude and breadth of potential ecological benefits and adverse consequences, reversibility, time required to demonstrate results, and information richness.

These comments are focused primarily on the aquatic component of the Conservation Strategy, given the even less developed status of the strategy's terrestrial component and without any implication that the terrestrial component is satisfactory. We will comment on the terrestrial component when there is a more detailed strategy to review. Nonetheless, we believe these comments are relevant to the development of the terrestrial component.

DETAILED COMMENTS ON CHAPTER 3 (CONSERVATION STRATEGY)

<u>Desired outcomes for the recovery and restoration of covered species or the Delta ecosystem are not sufficiently defined and expressed as goals and objectives</u>

By definition, the desired outcomes of a HCP/NCCP are recovery of ESA listed species and restoration of ecosystem function. For species recovery, desired outcomes should be expressed as goals and objectives in terms of scientifically supported criteria for viable, sustainable populations, including abundance, distribution, diversity, and population growth rates (e.g., McElhany et al. 2000; Lindley et al. 2007). Clear and measurable goals and objectives for recovery and restoration of the covered species and the Delta ecosystem allow decision makers, plan implementers and the public to assess the adequacy of the BDCP and its components (such as this Conservation Strategy) and to measure success and failure of those plans once implemented. The adequacy of individual conservation measures and of a suite of such measures cannot be evaluated if it is not clear what they are intended to accomplish.

Acceptable goals and objectives for covered species would specify desired states of abundance, spatial distribution, life history diversity, population growth, and acceptable return rates for catastrophic disturbances (e.g., Lindley et al. 2007). The first four of these attributes are clearly identified in Figures 3-2 and 3-3, but they are mischaracterized in the former diagram as less quantitative and less certain than BDCP goals and objectives. In fact, ESA recovery planning documents (identified in Figure 3-3 as the least quantitative and least certain level of the goals and objectives pyramid) are typically much more specific regarding desired outcomes than most of the goal or objective statements in this Conservation Strategy. The hierarchy depicted in these two figures erroneously and arbitrarily depicts "BDCP Goals and Objectives" as distinct from "Attributes of Viability" (including abundance, diversity, spatial distribution, and population growth rates). Goals of the BDCP regarding covered species must incorporate these attributes and the desired state for "catastrophic events" (*see* Lindley et al 2007). Goals for the ecosystem and natural communities must incorporate parallel variables (e.g. the desired magnitude, spatial distribution, and diversity of habitats; magnitude, timing and frequency of hydrograph characteristics, as well as changes in the rates of introduction and in the abundance and distribution of invasive species, reductions in contaminant loadings and/or bioaccumulation in covered species).

Specification of these desired outcomes is not to be confused with the determination of specific permit terms and conditions for any party to the final BDCP. However, it will not be possible for permitting agencies to evaluate the efficacy of the plan and determine final permit terms for the permit applicants absent the adoption of goals and objectives for the BDCP as a whole.

The current "goals" statements are improperly formulated because they incorporate particular hypotheses regarding attainment of the goal. The outcome of misstated and miscategorized goals is significant. For example, because these "goals" statements incorporate and assume particular hypotheses, this Conservation Strategy would allow attainment of "goals" by simply completing objectives or conservation measures, even if the real goals (species and ecosystem recovery) are unaffected by those achievements. So, for example, Goal ECSY2 ("*increase aquatic primary and secondary production in the Delta and Suisun Marsh to increase the abundance and availability of food for native aquatic organisms*") assumes that primary and secondary production of food limits covered species populations. This is one hypothesis regarding the cause of the decline in covered fish species, but what if this hypothesis is not true or true only in a limited sense? By contrast, Goal GECF1 ("*increase the abundance of covered fish species by reducing sources of unnatural mortality*") speaks to a different hypothesis regarding covered species decline. The point of the adaptive management framework for the BDCP is to determine which of the various hypotheses (or combination of hypotheses) relates to the actual stressors limiting covered species and causing ecosystem decline – incorporating these hypotheses into the goals confuses the means with the ends and provides no definition of the desired endpoint the Conservation Strategy is attempting to reach. No one will be able to evaluate the efficacy of the Conservation Measures (which are based on hypotheses about what prevents us from attaining recovery objectives) or a suite of these measures unless there is an accepted set of goals that this Conservation Strategy is trying to attain. The BDCP process should not generate a permit under the Endangered Species Act for solving hypothetical problems that do not produce species recovery.

Objectives should describe how the Conservation Strategy aims to achieve its goals and present verifiable thresholds and milestones that reflect progress toward the goal. Objectives define the goal through statements that are specific, measurable, achievable, relevant to the goal, and time-bound ("SMART"). The "objectives" statements in Chapter 3 do not provide such specific guidance regarding achievement of goals. Very often, the "objectives" stated in Chapter 3 are meaningless variants on the "goal" statement (i.e. they do not add any new specificity or content to the plan) and/or do not actually refer to the goal they are intended to accomplish. In nearly every case, they lack the specificity required to call them an "objective". As with the goals statements, throughout the document objectives are riddled with words like "increase", "reduce", "contribute to", and "create conditions" but it is not clear what level of change from current conditions is sufficient to achieve the desired condition. Without describing targets and thresholds via objectives statements that are SMART, it will be impossible to determine whether objectives (and their associated goals) have been met. For example, there is no way to evaluate the success or failure of objectives listed under goal SASP1 (*Maintain and conserve a self-sustaining population of Sacramento splittail in the Delta*; p. 3-42) because there is no definition of the specific targets (variables and parameters) that constitute successful achievement of:

Objective SASP 1.1 (*Contribute to increasing the abundance of Sacramento Splittail within the Delta and Suisun Bay*)
Objective SASP1.2 (*Maintain the distribution of Sacramento splittail ... to achieve target distribution values*)
Objective SASP1.3 (*Maintain connectivity between ... Sacramento Splittail populations*)
Objective SASP1.4 (*Maintain multiple spawning cohorts of Sacramento Splittail as part of the breeding population*)

The problems created by the pervasive absence or misformulation of measurable goals and objectives in Chapter 3 are exemplified in (but not isolated to) the section on goals for Delta smelt (section 3.3.6). The only specific goal for Delta smelt is to "*Create conditions that support a self-sustaining population of delta smelt...*". The required conditions are not described so it is not possible to evaluate whether this goal will be sufficient or to know when it has been achieved. The objectives identified with this goal are to "*Increase the abundance of delta smelt*

... to levels that will support a self-sustaining ...population" and "*Increase delta smelt population growth rates [under comparable hydrological conditions] to levels that will contribute to the long-term sustainability of the smelt population...* [p. 38]." Clearly, the objectives do not describe "conditions" that will support a self-sustaining population, which is the stated goal. Furthermore, it is difficult to imagine how an ESA-authorized Conservation Strategy could contribute to recovery of the Delta smelt population *without* increasing abundance and population growth rates to levels that "support long-term sustainability". The Conservation Strategy must offer far more specificity than this. Without details and appropriate structural relationship between goals, objectives, and conservation measures, there is no way to tell whether or not the Conservation Measures will achieve their objectives, nor when/if the objectives have been fully achieved after the final strategy is implemented.

In part, the absence of measurable goals and objectives from Chapter 3 appears to be by design. The Conservation Strategy states that the biological goals and objectives (and monitoring metrics and the foundation for adaptive management) to be addressed by habitat restoration will be developed in "habitat management plans" (p. 93) and that these will "*tie back to the underlying goals and objectives of the BDCP*". We agree that specific Conservation Measures should be linked to specific goals and objectives that support attainment of the overall goals of the Conservation Strategy; these will be necessary to determine whether (a) the final Conservation Strategy includes sufficient measures to achieve its goals and objectives and (b) the Conservation Measures actually worked. However, there is no reason from either a legal or scientific perspective to leave the description of goals and objectives to future planning and in any case there are no measurable overarching goals and objectives to "tie back to" in this Conservation Strategy.

In short, this draft provides few project-specific measurable goals or objectives identified in the Conservation Strategy and no overarching goals (desired conditions) that the Conservation Strategy is attempting to produce. The Conservation Strategy promises that its biological objectives will " *... express measurable targets for achieving the biological goals*" [p. 3] but it does not deliver on this promise. Neither the "goals" nor "objectives" identified throughout the document and summarized in Table 3.2 are measurable outcomes; instead descriptions such as "increase", "reduce", and "create conditions", etc., are used to define the desired outcome but questions like "how much?" and "what conditions?" are not answered. This lack of clarity also applies to the Plan's desired outcomes for water supply. The draft Strategy identifies (but does not describe, define or quantify) an additional goal for "reliable water supply" (Page 3-52, line 23; page 3-53, lines 2-3) and states that this goal has influenced development of flow-related and water operations conservation measures. Absent clear and measurable ecosystem and water supply goals, it appears that proposed modifications to measures to address freshwater flows, in-Delta barrier operations (including installation of new, untested barriers with hypothetical and therefore unknown effects on either the ecosystem or species) and South Delta export operations are primarily designed to reduce impacts to water supply rather than to modify ecosystem conditions in ways and at levels indicated by scientific understanding of the system to best achieve species and ecosystem goals.

Perhaps as a consequence of its confusion regarding Goals and Objectives, the Strategy does not identify the overall physical and biological outcomes that the BDCP must address in order to produce the Goals and Objectives. Rather, the plan assumes a factual basis for hypothetical barriers to achieving unstated biological goals. SMART objectives are accomplished by addressing hypotheses regarding what currently prevents attainment of the goals. The objective statements themselves should be agnostic as to the preferred or likely pathways to attaining that goal. Rather than simply stating the desired conditions that define recovery goals, the objectives in Chapter 3 often adopt particular hypotheses about current barriers to attainment of the goals (see discussion above). This practice inappropriately obscures the fact that, in many cases, numerous hypotheses regarding ecological stressors caused by human activities are being considered and studied and that some of these hypotheses have stronger support in the literature than others. Instead, the Strategy must identify these (sometimes competing) hypotheses in order to develop conservation measures that will alleviate hypothesized stressors. These hypotheses, their likely importance, and their degree of scientific support come from conceptual models for each species and the ecosystem as a whole. Many relevant conceptual models have already been developed by the Delta Regional Ecosystem Restoration Plan (DRERIP) process but they do not appear to have been referenced in compiling the Strategy presented in Chapter 3. In addition, for each potential impediment to attaining recovery goals (hypothesis), the Strategy should identify what level of change would be required to significantly reduce or eliminate that stressor (we refer to this as "desired change"). This level of ecosystem change sets the context for understanding how individual conservation measures (and interactions among the measures) fit into and contribute to attainment of the goals and objectives.

Disaggregating SMART objectives from hypotheses regarding stressors that prohibit attainment of goals is essential for evaluating the Strategy prior to and following implementation.
Prior to plan implementation, decision-makers and the general public will want to know that significant and adequate resources are directed towards those stressors that are most likely to produce the recovery objectives/goals. Similarly, if an objective/goal does not materialize following plan implementation, we will need to know whether that is because (a) the conservation measures designed to produce the desired conditions (objectives) were insufficient or (b) the underlying hypothesis that links conservation measures to objectives (i.e. regarding stressors and limits) is untrue.

Existing scientific information is inadequately incorporated and/or incorrectly characterized in numerous cases, severely undermining the foundation for the proposed suite of actions.

The scientific justification for goals, objectives, and conservation measures is poorly and selectively documented. Statements that require, but are missing, reference to a published scientific paper occur on almost every page of the Conservation Strategy. There is not a single scientific citation provided in the sections that describe the goals and objectives, even though these sections claim to describe species-specific and ecosystem-specific recovery needs and stressors. Conservation measures with no citation of supporting scientific studies include:

- WOCMN6 & WOCML6 (Rio Vista Flows, near and long-term);
- WOCMN8 (Two Gates)
- WOCMN14 & WOCML14 (in-Delta water quality requirements, near and long-term).

In other cases, the scientific documentation in support of proposed conservation measures is inexplicably sparse. For example, HRCM11/HRCM14 (*Restore at least 5000ac of riparian forest and scrub*). This proposal cites just two papers, one to support each of two hypotheses. However, two other hypotheses have no citations and neither does the associated "problem statement". There are several statements in this description that ought to be supported by research papers or other scientific literature (e.g. that the restoration measure will support yellow-breasted chat, riparian brush rabbit, riparian woodrat, Suisun Marsh Aster, valley elderberry longhorn beetle, Swainson's hawk, production of zooplankton and macroinvertebrates; pp. 113-114).

In addition, there appear to be no references to publications that focus on the ecological requirements or conservation status of either of the two lamprey species that the Conservation Strategy is supposed to consider. Lamprey are physically and ecologically very different from the other covered species, but no support is provided for the assumption that Conservation Measures intended for other species will benefit the lamprey.

Another example where Chapter 3 makes extremely limited and selective reference to the scientific literature is in the description of WOCML1 (New North Delta Water Diversion Facility). In seven pages of text, reference is made to only three citations, while numerous relevant peer-reviewed publications are not cited (e.g., Rosenfield and Baxter 2007; Swanson et al, 2004; Swanson et al, 2005).

Throughout Chapter 3, the Conservation Strategy appears to cite literature in a selective and biased way. The BDCP Independent Science Advisory panel recommended in their report submitted to the BDCP (2009) that: *"...the technical documents that form the basis of the BDCP plan and conservation actions be reviewed by independent technical experts to ensure the credibility of the program and a sound foundation for conservation actions*" [p. 6]. Only in rare cases (see below) are there citations of documents that question the hypothetical basis for a Conservation Measure and, as a result, there is little indication of the uncertainty associated with most of the proposed Conservation Measures. Indeed, this bias appears to be somewhat intentional, as the consultants state:

> [the "Hypothesis" section of each conservation measure] *describes the hypotheses that justify the approach reflected in the conservation measure. Uncertainties and risks that could be associated with DRERIP-evaluated conservation measures are described in Appendix X, DRERIP Evaluations*. (p. 45)

First, "hypotheses" do not "justify" an "approach" – hypotheses are *potential explanations* of the cause and effect relationship between different forces. They stem from observations that are consistent with the hypotheses but they are, at their very base, *hypothetical*, and require rigorous testing before they can be used to "justify" any action or approach. Second, relegating "uncertainties" and "risks" associated with a conservation measure to an appendix is the very definition of a biased presentation and is an unacceptable way to present a hypothesis that underlies an objective or conservation measure. Decision-makers must understand the risks and uncertainties associated with objectives and conservation measures in order to prioritize among them. Instead, because the Conservation Strategy presents only information supportive of its hypotheses and does not include adequate tests of those hypotheses, readers are presented with the inaccurate impression that (a) the hypotheses are well supported by current knowledge and (b) that each of the hypotheses (and their associated conservation measures) are equally well-supported.

The Conservation Strategy routinely relies on anecdotal information or overstates or misrepresents the scientific basis for hypothesized impacts of its Conservation Measures – the ISAP (2009) report complained of the same kinds of problems in early versions of the BDCP report. Many of the descriptions of Conservation Measures improperly cite:

- unpublished and unreviewed presentations or "personal communications" as if they were peer-reviewed science
- papers that make a completely different and/or contradictory point to that implied by the reference
- sources in a way that implies support for the logic underlying an entire statement when, in fact, the sources only refer to a particular part of the statement.

For example, given that Conservation Measures (HRCM4-HRCM9) are intended to restore tens of thousands of acres of fresh and brackish water tidal marsh, one expects a sober presentation of a wealth of scientific research that would support the underlying hypothesized effects, as well as a balanced description of potential risks and uncertainties associated with such a massive undertaking. In fact, the Conservation Strategy references only four papers in the description of these actions and several of these are not valid citations. For example, "Siegel 2007" is a *draft* conceptual document that identifies itself as a "starting point" for collaborative visioning. The paper clearly states, "*This document is incomplete and not fully vetted*" [p. 2]. Not only is the paper not peer-reviewed (probably because it was never meant for publication or citation), it does not cite any references of its own. Although the author of this presentation is a highly respected member of the regional restoration science community and his views carry great weight, this draft paper amounts to opinion (in this case, about the *planning process* for restoration) and should not be used to substantiate the claims (it is cited 15 times) with which it is associated in Chapter 3.

Similarly, the Conservation Strategy cites "C. Enright pers. comm." in several places where it claims that tidal marsh restoration may "*expand areas of cool water refugia for delta smelt*". These claims wildly overstate the likelihood of this benefit materializing at any of the proposed tidal marsh restoration sites. During the presentation referenced here, Mr. Enright noted that the cooling effect associated with higher high tide events occurs only in specific places and at particular times and results from a unique combination of geomorphology and tidal cycles.

Indeed, his presentation had to do with the *uncertainties* associated with tidal marsh restoration, not predictions about an unusual cooling phenomenon occurring in a biologically meaningful way at planned restoration sites.

In another example of the misuse of scientific citations, a publication by Brown (2003) is referenced in a way that suggests that the author found that tidal marsh restoration would "increase rearing habitat area" for several covered species. In fact, this article questioned many of the presumed benefits of tidal marsh restoration. Quoting from the abstract of that paper:

> *There are few quantitative data to suggest that restoration of tidal wetlands will substantially increase populations of native fishes. On a qualitative basis, there is some support for the idea that tidal wetland restoration will increase populations of some native fishes; however, the species deriving the most benefit from restoration might not be of great management concern at present.*

Chapter 3 cites unpublished (and unavailable) reports by both Manly (p. 58) and Miller (p. 83) as if they were published papers. Neither of these individuals is a professional biologist and their analyses are regularly refuted and dismissed by those who study this ecosystem for a living. It is questionable, inappropriate and highly unusual to reference these unpublished documents in the Conservation Strategy as if they lent merit to the document – they do not.

In addition, the Conservation Strategy cites the unpublished work-product of the consulting team as "personal communication". For instance, personal communications or unpublished data from A. Munevar are referenced five times (pp. 79, 82, 84, 111); as Mr. Munevar is a member of the BDCP consulting team, his analyses should be available for presentation in this document. If these analyses form the underpinning of a predicted desired outcome, the results should be presented and described in this document.

There is an even bigger problem with the draft than its citation problems, namely, the fact that it persistently ignores, dismisses or diminishes strong scientific evidence regarding the stressors driving species and ecosystem decline and the likely impact of implementing various conservation measures. As the ISAP (2009) report found, "*far more is known about the Bay-Delta ecosystem than is suggested...*" (ISAP 2009, p. ii). This statement likely refers, in part, to the known benefits to estuarine and anadromous fish species of increased flows of fresh water through the Delta during the springtime. Yet, in the description of Conservation Measures WOCMN9 & WOCML9 *(Maintain sufficient Delta outflows in the near and long term)*, the consultants cite only Kimmerer (2004) in support of the concept that Delta outflows are strongly correlated with abundance of fish species in this estuary. As has been pointed out numerous times previously (see, for instance, the December 3, 2008, memorandum from TBI to BDCP work groups regarding review of conservation measures, and the February 28, 2009, memorandum from TBI regarding the PRE Memo "Rationale for Changing X2 Objective") the statistically significant, continuous relationship between fish abundance and X2 (or outflow) has been documented over several decades for two covered species (longfin smelt and Sacramento splittail) as well as several other fish and invertebrate prey species (e.g., Jassby et al 1995;

Kimmerer 2002; Rosenfield and Baxter 2007; Sommer et al. 2007; Kimmerer et al. 2009). Various studies have shown an abundance:outflow relationship for Chinook salmon (e.g. Baker and Morhardt 2001; research cited in Williams 2006) and Stevens and Miller (1983) demonstrated a strong relationship between Chinook salmon success and Delta inflow (inflow and outflow are strongly correlated). The Conservation Strategy cites several of these papers elsewhere (e.g. Kimmerer 2009; Baker and Morhardt 2001), so their absence from the "problem statement" associated with these two conservation measures is glaring.

Also striking is the reiteration of the argument that because the abundance: outflow relationships have "changed" over time, the mechanistic relationships between fresh water outflow and fish abundance may no longer exist. There is simply no evidence of this for covered species, as we have continually pointed out to the consultants. Kimmerer (2002) and Kimmerer et al (2009) find that the slope of the relationship between abundance and X2 is unchanged over time for either splittail or longfin smelt. Rosenfield and Baxter (2007) and Sommer et al. (2007) also found no change in the slope of the abundance:outflow relationship for longfin smelt. Each of these authors employed widely accepted statistical techniques to compare the slopes of the different lines and found that there was no difference in the slope of the line. What has changed is the intercept of the abundance:outflow (or X2) relationship, but the correlation between Delta outflow and the abundance of many estuarine species is unchanged and remains statistically significant. Inclusion of this specious line of reasoning, in the face of so many published articles to the contrary, is inexplicable.

The Conservation Strategy also does not incorporate the results of an intensive scientific review conducted earlier this year for the very purpose of documenting the potential benefits and risks and uncertainties associated with these Conservation Measures. This review employed a process developed by the California Department of Fish and Game's Delta Regional Ecosystem Restoration Implementation Planning process ("DRERIP review") and engaged many of this Estuary's most respected scientists to refine, assess, and document the scientific basis for the hypothesized benefits and negative effects of these proposals. Although the DRERIP review process was never fully completed and, as a result, its preliminary products contain some inaccuracies, it nonetheless represents the most thorough scientific review available to the BDCP and provides a significant contribution to understanding the potential impacts (positive and negative) of implementing the Conservation Measures process (see the August 17, 2009, memorandum from TBI to the BDCP Steering Committee regarding DRERIP review).

Yet the outcomes of the DRERIP review appear to be absent in the very document it was supposed to inform. For example, at the coarsest level, the DRERIP review of tidal marsh restoration actions found that proposed restorations in the South Delta and East Delta (HRCM7 and 8) would have, at best, minimal to low positive impacts on covered species and that even these impacts were highly uncertain. Indeed, these proposals were associated with potentially high magnitude negative impacts for all covered species. Similarly, for most covered species, OSCM14 (*Increase harvest of non-native predatory species*), WOCM1a (*New North Delta Diversion*), and 2-gates proposal version "a" (*Construct and operate two-tidal gates in the South Delta*) were believed to have potential negative outcomes of greater magnitude than their most positive potential outcome. In general, proposals OSCM13 (*Selective removal of invasive plants*) and OSCM17 (*Splittail Harvest Regulation*) were believed to have potential negative outcomes of similar magnitude to their potential positive outcomes. Chapter 3 does not mention these results or similar findings (potential negative outcomes equal to or greater than potential positive outcomes) for other Conservation Measures concerning particular covered species.

For some Conservation Measures the draft does appropriately cite numerous relevant peer-reviewed scientific publications. For example, WOCML2 (*Modify the Fremont Weir and Yolo Bypass…*) references over 15 publications in just 3 pages of description. Similarly, HRCM1/HRCM2 (*Restore 10,000 acres of seasonally inundated floodplain habitat*) references numerous scientific studies as observations that support its underlying hypothesis (perhaps not coincidentally, many of the citations are the same as those referenced in WOCML2). But these examples only highlight the fact that major sections of the Conservation Strategy display inadequate or inaccurate scientific documentation. The lack of documentation cannot be attributed to the "novelty" or uncertainty surrounding certain Conservation Measures. For example, OSCM1 (*Determine whether ammonia/um have adverse effects on covered species*), OSCM2 (*Determine whether endocrine disrupting compounds have adverse effects*); OCSM3 (*MethylMercury*); and OSCM4 (*Reduce the load of agricultural pesticides and herbicides*) appear to be among the better documented conservation measures despite (or perhaps because of) significant uncertainties surrounding their effectiveness.

Finally, there is extensive information available in the scientific literature on the range of potential climate change related impacts, but this critical topic is insufficiently addressed. For instance, although the draft acknowledges the impact of global climate change on the availability and location of habitats in the future (p. 93), there is no consideration of the impact of increased water temperatures (discussed briefly in Chapter 2) on covered species. Failure to consider the impact of increasing water temperatures under global warming scenarios results in failure to address extremely important questions such as: to what extent can water temperature changes in the Delta be controlled or mitigated using potential Conservation Measures? Are Conservation Measures upstream of the Delta necessary to provide temperature refugia for some of the covered species in the event that intolerable water temperatures become more common in the Delta in the relatively near future?

<u>Projected outcomes of implementing conservation measures are insufficiently and/or incorrectly described, casting a high degree of doubt on the efficacy of the proposed plan.</u>

At times, the Conservation Strategy projects outcomes that are inaccurate, highly unlikely, or result from speculation Throughout the document, hypotheses regarding both stressors that impede attainment of objectives (*see above*) and conservation measure effects are confused with facts and then hypothetical outcomes presented as certain or likely outcomes. Many of the Conservation Measures are clearly designed around untested hypotheses rather than any empirical or even conceptual understanding of the ecosystem or species. From the perspective of correct application of adaptive management principles, these measures (and their hypothesized outcomes) should be evaluated as having unknown magnitude of positive outcomes, high uncertainty, and unknown risk of negative outcomes. By contrast, the magnitude of likely outcomes that are well supported by extensive scientific literature (e.g. spring outflows from the Delta) are minimized or their degree of certainty is downplayed (see TBI comments cited above).

Many of the outcomes anticipated by the Conservation Strategy's conservation measures are speculative, highly unlikely to materialize, or of minimal benefit to covered species. For example, the assumption cited earlier that tidal marsh restoration will result in cooling of water temperatures in a way that supports Delta smelt (e.g., p. 96) is based on a mischaracterization of preliminary research findings from Suisun Marsh; the researcher referenced does *not* suggest that this phenomenon is likely to occur in a meaningful or relevant way elsewhere in the Estuary. As another example, there is no reasonable expectation that proposed restoration of freshwater tidal marshes will "improve delta smelt and longfin smelt *spawning* habitat conditions" [p.95], even if those conditions were believed to be limiting, because very little is known about the specific characteristics of successful spawning and incubation habitats for these species. Without this basic information, it is not possible to determine whether tidal marsh "restoration" will create or destroy spawning habitats for these two species. For this reason, the DRERIP review's tidal marsh evaluation team did not consider this outcome worthy of review. Another example of overreaching and overemphasizing imagined positive outcomes of habitat restoration is the expectation that reducing periodic low dissolved oxygen events in Suisun Marsh (p. 107) will significantly benefit covered species – the DRERIP review evaluation (as updated August 2009) indicates that any positive outcome of this effect will be very slight.

The Conservation Strategy relies heavily on the assumed ability of restored physical habitats to export food resources to fish elsewhere in the Estuary (and the related hypothesis that covered species populations have declined as a result of food limitations). Yet, the magnitude of this outcome, its certainty, and the underlying hypothesis regarding food limitation are disputed. Invasive species may consume much of the productivity produced on restored tidal marsh; indeed, restored sites may act as sinks for food items (e.g., Dean et al 2005). Similarly, restored marshes may support predatory fish species to the detriment of covered species. The productivity from certain sites may not rise to a level that produces a noticeable population impact (this calls out the need to identify "desired changes" so that the projected outcomes of particular measures can be viewed in the context of the magnitude of change required to alleviate particular stressors). Across the proposed tidal marsh restoration projects reviewed, the DRERIP review's tidal marsh evaluation team rated the magnitude of the "regional food productivity impact" between High and Low and the certainty between Medium and Minimal (DRERIP Evaluation Summary Report, Appendix D). No mention of this high level of uncertainty is found in Chapter 3. Similarly, the consultants posit outcomes of the West Delta Tidal Marsh restoration proposal [HRCM6; (a) create a continuous reach of tidal marsh food production and (b) provide tidal marsh habitat within the anticipated future eastward position of the low salinity zone] that have already been dismissed or re-characterized by the DRERIP evaluation team.
(In contrast, Conservation Measures based on advanced conservation concepts that differ from the food limitation hypothesis are insufficiently developed and their projected outcomes unevaluated. For instance, the concept that "improved flows" will resemble the "natural

hydrograph" (e.g., p. 27-28) – strongly supported by the scientific literature, as noted above – should have been developed further, as well as the idea that modification of Delta flow patterns can influence the "strength of migration cues" for anadromous fish populations (pp. 59, 61). Unfortunately, neither of these approaches receives sufficient attention in subsequent Conservation Measures. Similarly, while the Conservation Strategy acknowledges the importance of maintaining life history diversity (e.g., in the specific objectives for Chinook salmon (p. 39) and Steelhead (p. 41)) and increasing the number of spatially independent spawning areas for covered species (p. 91, 96), again, these concepts are not well reflected in the conservation measures. Similarly, the Conservation Strategy acknowledges the important function of freshwater flow through and out of the Delta (e.g., pp. 56; 60-61); however, other than mentioning them, the Conservation Strategy does little to support many of the presumed mechanisms that link fresh water flow with increased abundance of covered species. For example, although Chapter 3 acknowledges that fresh water flows help transport eggs and larval fish to rearing grounds beyond the Delta (pp. 7, 60, 62), there is no indication that any of the Conservation Measures were designed to actively support this mechanism).

Throughout the document, the putative needs of Chinook salmon are assumed to be shared by steelhead. The phrase "and possibly steelhead" is used many times in the document where this inaccurate assumption is made. No literature on steelhead is presented to support such an assumption; indeed, steelhead have different ecological requirements and very different life history than Chinook salmon. Thus, for instance, the belief that steelhead are limited by poor growth in the estuary (p. 41) is unsubstantiated. Also, there is no evidence to indicate that steelhead make extensive use of floodplains such as the Yolo bypass or that limited access to floodplains is what constrains their populations in this ecosystem (though the citations on p. 82 incorrectly imply that there is substantial research on this topic). Nor is there evidence that steelhead (or Chinook salmon) make extensive use of or benefit substantially from tidal marshes in *this* ecosystem (as suggested on p. 102). The fact that steelhead may not benefit from every project intended to benefit Chinook salmon is not reason to abandon projects that may benefit only the latter species; however, the unfounded assumption that what benefits one species will benefit the other occurs throughout Chapter 3 and presents real cause for concern for the recovery prospects of species like steelhead under this Conservation Strategy.

The clearest examples of Conservation Measures developed without any empirical evidence for their support as well as limited conceptual understanding of their likely impacts on the ecosystem and covered species are among the near-term and long-term water operations conservation measures. For example, the Conservation Strategy assumes (and places substantial reliance) on the construction and operation of the proposed North Delta diversion facility (WOCML1) to provide multiple ecosystem and species benefits. However, beyond limited and invalidated hydrodynamic and particle tracking analyses (which must be evaluated cautiously given the large deviations in channel geometry and hydrodynamics compared to the parameters upon which the models were developed), there is insufficient scientific understanding of how these facilities and new operations will affect either the ecosystem or species' responses. Therefore, the magnitude and certainty of the predicted positive outcomes described in the Conservation Strategy are in fact unknown. In another example, the draft states that "Maintaining bypass flows will maintain adequate flows in the mainstem Sacramento River and distributaries downstream…for covered fish species" (p. 3-78). However, there is no description of what "adequate flows" downstream would be for each of the covered species, and it is not necessarily true that flows intended to minimize entrainment at the proposed diversion facility (bypass flows) are equal to those required to support other ecological processes downstream.

An additional problem throughout the draft is that potential negative effects of proposed Conservation Measures are not appropriately described or evaluated. Chapter 3 must clearly describe the risks and uncertainties associated with objectives and conservation measures; without such a presentation, there can be no sensible assessment of the merits of different proposals or of the Conservation Strategy as a whole. Certainly, in order to prioritize actions proposed in this Conservation Strategy, decision-makers must understand the magnitude of the proposed benefit, the likelihood that the benefit will arise, and the likelihood and magnitude of unintended negative impacts connected to the proposed objectives and actions.

For example, the Conservation Strategy fails to consider and discuss potential negative outcomes and risks of the proposed North Delta diversion facilities and operations (WOCML1). Establishing such a large new diversion in such a complex water body is likely to produce changes that may have negative consequences for covered species; the outcomes of such a major change in Delta hydrology are obviously uncertain. Although the diversion facilities will be equipped with "state of the art" fish screens to reduce entrainment losses, the Strategy fails to evaluate the potential impacts of increased exposure durations (due to long screens at multiple sites), the increased proportion of emigrating Sacramento basin salmonids exposed to the multiple diversions on their main migration route (compared to the likely smaller proportion currently exposed to the more distant South Delta export facilities), or the effects of relocating the diversion closer to apparently preferred delta smelt spawning habitat in the North Delta. The potential for predators to concentrate in the area of intake structures is mentioned (p. 79), but only in the context of a hypothetical means of limiting their impact (bypass flows). If predators are "likely to reside near intake structures", a full description of that (and other) potential problem should be included along with the description of hypothesized benefits.

Furthermore, actions may result in positive outcomes under some circumstances but not others. For example, Chapter 3 calls for increasing "*the connectivity of natural communities across the Delta and the connectivity with communities upstream and downstream of the Delta to support … genetic exchange of covered species…*" (Goal ECSY5; p. 3-35); yet the plan does not acknowledge that the lack of connectivity is what maintains genetic distinctiveness among relatively independent spawning populations (e.g. of salmon, steelhead, and splittail), keeps invasive species from colonizing new habitats, and prevents the spread of potentially catastrophic diseases within populations. In other words, connectivity among habitats is a fine idea, as long as the potential downside of inappropriate application of this mechanism is acknowledged and measures to minimize those negative effects are employed.

In another troubling instance of overlooking potential negative outcomes, the draft ignores the extensive scientific literature on the adverse impacts of hatchery operations on native species.

Contrary to its stated intention of "*…contribut[ing] to the restoration of the health of the Delta's ecological systems by focusing on ecological functions and processes at a broad landscape scale and not by just addressing its discrete parts*" [p. 2], the Conservation Strategy includes specific measures that can only be viewed as efforts to support populations of particular species with little regard for (a) the stressors causing these species to decline or (b) restoration of ecosystem "health". For example, the Conservation Strategy calls for creation of a hatchery to support Delta smelt and longfin smelt populations (OSCM 20). This proposal is extremely ironic given the space in Chapter 3 dedicated to mitigating the negative impact of salmonid hatcheries on wild Chinook salmon and steelhead (e.g., pp. 33, 161-164). Why would the proposed smelt hatcheries not constitute similar threats to smelt species? Indeed, given that salmon hatcheries have been operated and studied for well over a century and still jeopardize the persistence of wild salmon populations (e.g., Lindley et al 2007) and given that no one has ever constructed and operated a Delta smelt hatchery or a longfin smelt hatchery, it seems likely that smelt hatcheries would present additional risks to their respective covered species.

These risks and extreme uncertainties aside, the Conservation Strategy cannot make the case that smelt hatcheries "*…contribute to the restoration of the health of the Delta's ecological systems by focusing on ecological functions and processes at a broad landscape scale*". Hatcheries facilitate the production of larvae and juveniles from fish eggs, but the Conservation Strategy presents no evidence that either smelt species is limited by production of its larvae from eggs. Even if that were a problem faced by covered smelt species, the solution would be to provide ecological conditions that supported smelt production *in the wild*. Furthermore, hatchery-produced fish (e.g. salmon) are often excluded from estimates of endangered species' population status in making ESA-determinations regarding listing and recovery. Thus, it is not clear that hatchery-produced smelt would contribute, in any way, to the goal of recovering these species in an ESA-context. This is but one of many examples of misplaced conservation efforts that demonstrate the need for the Conservation Strategy to transparently address key stressors (hypotheses) identified in conceptual models of ecosystem function or species and the associated level of ecological or physical changes ("desired changes") required to alleviate those stressors (see below).

The proposal to implement a mark-select fishery is another clear example of a Conservation Measure that focuses on discrete parts of the ecosystem (the Chinook salmon adult life phase) and does nothing to restore ecological processes. Whereas a mark-select fishery is intended (though not proven) to increase the number of wild adult fish returning from the ocean to spawn, there is no evidence that increasing the number of spawning adults returning to Central Valley streams will significantly contribute to the long-term population recovery of these species. Freshwater spawning and rearing habitat are clearly limiting Chinook salmon population productivity. For example, winter-run Chinook salmon returns in 2008 were less than 1/3 of their average during this decade despite the fact that the fishing season was entirely closed during 2008; poor water temperature conditions on their Sacramento River spawning grounds probably meant that not even all of these fish could find suitable spawning and incubation habitats. We note that this measure covers impacts that are clearly out of the BDCP planning and implementation area and conveniently offers to restrict other industries (commercial and sport fishing) while allowing proponents of the BDCP to continue activities that impact ecological conditions in the Delta.

Whereas the Conservation Strategy does not do an adequate job of fairly characterizing the likely impacts of implementing proposed Conservation Measures, almost no attention is given to the likely interaction of these measures. There appears to be some understanding in the draft that modifying major components of the Delta hydrology and ecosystem will have impacts that resonate throughout the system, but no effort has been made to explain how one action will impact another. For example, the restoration of tidal marsh habitats will inevitably change tidal dynamics, flows, and water elevations throughout the Delta (Munevar, A. SAIC Consulting Team, *pers. comm.*; Friedrichs and Perry 2001). These impacts will, in turn, affect the outcome of other tidal marsh restoration efforts since outcomes rely very heavily on tidal prism and elevations. Simply put, one cannot understand the likely inundation and marsh evolution dynamics (depths, frequencies, residence times, vegetative development, etc.) at one proposed restoration site unless one understands the hydrological impact of other restoration actions.

Similarly, because the Conservation Strategy relies heavily on the hypothesis that food limitation is the immediate constraint on population growth of all covered species, there should be an analysis of the interaction among different measures that are anticipated to produce food for covered species. At some point, creation of food resources will have diminishing returns (if Delta food resources are actually limiting these populations at all). For instance, if restoration activities on the Yolo bypass increases food availability and growth of emigrating salmonid juveniles, how will this affect the magnitude and certainty of similar projected outcomes from tidal marsh restoration in the western Delta or Suisun Marsh? Of course, answering these questions requires that the Conservation Strategy estimate the projected outcomes (in terms of contribution towards alleviating hypothesized stressors by achieving desired levels of change) that will accrue to each covered species from each anticipated outcome of each Conservation Measure. Producing such estimates is necessary in order to understand the expected overall impact of the Conservation Strategy and to comprehend how each of the Conservation Measures contributes to achieving the objectives and overall goals of the Conservation Strategy.

Finally, it is obviously difficult to evaluate impacts where key components of the Conservation Strategy have not been defined. Throughout the document, blank spaces appear in places where conditions should be defined numerically. This failure to parameterize key operational or ecological variables prevents evaluation of the specific measures in question and, to the extent that Conservation Measures interact, the rampant lack of specificity makes the entire package opaque and inadequate. Near-term and a range of long-term operational parameters have subsequently been proposed for evaluation that raise a number of serious objections (see the July 21, 2009, and September 16, 2009, letters from TBI, Defenders, and EDF to the BDCP Steering Committee regarding our opposition to the characterization of the range of long-term operational parameters and to the selection of insufficiently protective near-term parameters for evaluation).

<u>Adaptive management is insufficiently incorporated into the design and selection of conservation measures, undermining the plan's ability to respond robustly and credibly to new information and changing conditions.</u>

Adaptive management is not something that is simply added to a plan. To the contrary, the principles of adaptive management – the identification of problems to be addressed, goals, the insistence on clear and measurable outcomes, the formal application of conceptual models and other tools, the prioritization of potential actions according to certainty, magnitude and timeliness of benefit, application of the precautionary principle (i.e. reversibility and assessment of risks), and information richness, collection of data that can specifically address the efficacy of actions, and the identification of a clear decision making process for evaluating and modifying performance – should guide the development of the plan from the very beginning.

Chapter 3 characterizes the Conservation Strategy as an adaptive management program (AMP) where knowledge gained in the implementation of the strategy will be used to refine, magnify the positive impact, and improve the efficacy of, the strategy over time. Adaptive management allows progress towards conservation goals in the face of uncertainty by continually expanding the knowledge base that underpins hypotheses about limiting factors in the ecosystem, implementing specific actions as experiments that test hypotheses, measuring and analyzing results of those experiments, and creating explicit feedback mechanisms between those results and future conservation management. This approach allows for rejection of hypotheses that are not supported by evidence and increased focus on actions that generate positive results. Much is not known about the forces driving the decline of covered species and ecosystem processes in the Delta, less is known about the implementation of certain actions envisioned to benefit covered species (e.g. restoration of vast areas of tidal marsh), and still less is known about the interaction of restoration activities that might contribute to species recovery. In its introductory material and in its section describing adaptive management (Section 3.6), the Conservation Strategy captures these sentiments well.

Unfortunately, the Conservation Strategy falls well short of the promise of adaptive management. In effect, adaptive management is imagined to begin after the Strategy is accepted and implemented. Instead, given a system as complex as the San Francisco Bay-Delta Estuary and a plan threshold of contributing to the recovery of endangered species and the conservation of natural communities, every component of the strategy should evolve from principles of adaptive management, from establishment and articulation of goals and objectives for the program as a whole, to selection, design, prioritization and sequencing of its conservation measures, to the creation of an entity tasked with collecting, managing, analyzing, and presenting results from monitoring of and research on the conservation measures. To be a successful AMP, the Conservation Strategy must embody adaptive management principles from beginning to end.

The Independent Science Advisory Panel's February 2009 report (ISAP 2009) makes excellent recommendations regarding the establishment of an adaptive management plan (AMP) for the BDCP. Given the failure to adopt those recommendations in this draft, it is worthwhile to review those recommendations in order to understand the current draft's shortcomings and identify an alternative approach.

Appropriate and Complete Application of the Knowledge Base (ISAP Principle 2): An AMP must rely on appropriate and accurate use of the knowledge base (including published scientific papers, data, unpublished analyses, and commonly accepted local knowledge about a system); the ISAP (2009, section 3.2) report criticized preliminary products of the BDCP for misuse and misapplication of existing scientific data and the problem is widespread in the current document (*see above*). In addition, a Conservation Strategy based on adaptive management will accurately represent the current state of knowledge about anticipated outcomes of conservation measures (and interactions among conservation measures) including the uncertainty and risks associated with those measures (and interactions); as noted above, Chapter 3 does not provide such a context for the various conservation measures.

Linkages between problem statements, goals, objectives, hypotheses, conservation measures, and metrics (ISAP Principle 3): The enunciation of goals and objectives in the Conservation Strategy is confusing at best and is often missing entirely. A nice conceptual description of a generic adaptive management plan (Section 3.6) notwithstanding, Chapter 3 provides no means for assessing the adequacy of the Conservation Strategy or the outcomes of its measures. What are presented as "goals" are either objectives, strategies, "primary constituent elements of critical habitat", or they are goals that are so generic that their adequacy and success/failure will be debated as soon as a plan is adopted. Even these are often presented in a confusing or circular fashion.

The ISAP (2009) report describes a linear framework for relating problems to goals and goals to objectives in order to increase clarity of the logic underpinning the Conservation Strategy. As noted above, that logic is currently missing or poorly articulated. Without a well-articulated logical basis, AMPs quickly become management-as-usual, where policies are created, changed, or abandoned based on the prevailing concern of the day. We expand upon the ISAP recommendations in calling for improved clarity of the Conservation Strategy's underlying logic, from problem statement to restoration action to evaluation procedures. These improvements should be applied both at the level of the Strategy's overarching goals and with regard to individual conservation measures.

Problem statements describe the problem that must be rectified. For covered species, the problem statement would describe their decline and any relevant research into the causes behind that decline. Similarly, for the ecosystem, the problem statement would describe the loss or degradation of ecosystem functions and the research that documents or illuminates the causes of the decline [we note that, throughout the document, "ecosystem processes" in need of rehabilitation are never defined].

Goals flow from problem statements and "*encapsulate desired future conditions*" [ISAP 2009, p. 6]. Several goals may be required to describe desired conditions for the estuarine ecosystem, target natural communities, and covered species. For instance, goals for covered species recovery should at least encompass desired conditions for abundance, spatial distribution of spawning populations, diversity (e.g., genetic, life history), and maximum return rate of catastrophic events (e.g. Lindley et al. 2007). The first three of these goals categories are acknowledged within the existing Conservation Strategy, so there should be no argument regarding their importance. However, no tangible goals are established for any of them and the discussion surrounding them is unclear at best.

Objectives are "*specific, often quantitative, statements of outcomes that reflect the goals that the program is expected to achieve*" [ISAP 2009, p. 7]. As described above, they should be SMART statement (specific, measurable, achievable, relevant to the goal, and time-bound). The words "improve", "increase", "decrease" are not specific enough as descriptors of desired conditions to serve as objectives.

Hypotheses that underlie objectives must be stated explicitly, in a falsifiable manner. These hypotheses are derived from conceptual or other models (**ISAP principle 4**) about how a system works or how populations respond to different stressors. We share the impression expressed by the ISAP that the consultants skipped the formal analytical step of constructing (or referencing existing) models to identify key potential key stressors and feedbacks [ISAP, p. 7]. In order to understand whether the Conservation Strategy is likely to succeed, decision-makers will need to evaluate the underlying assumptions of the approach. If many of the conservation actions assume the veracity of a single hypothesis about limitations/stressors in the current ecosystem, the standard for scientific support of that hypothesis will be very high at the outset. One outcome of adaptive management is that hypotheses (and their associated objectives) will be discarded as information indicates that they are no longer valid. At some point, the authors of the Chapter 3 understood this principle as it is stated in the early pages of the Conservation Strategy; however, the Strategy that follows makes no reference to testing hypotheses and discarding ones that are not supported by results.

Predictions flow from the hypotheses in the form of **Desired Changes**. If a hypothesis is correct, then the attainment of the desired level of change will contribute significantly to the achievement of the objective – if the hypotheses are incorrect (i.e., this is not a stressor or other stressors prevent the anticipated response), then producing the "desired change" level will not produce an adequate population level response.

Conservation Measures are presented in the context of what they are expected to contribute to a desired level of change in a hypothesized stressor or they may address several hypothesized stressors simultaneously. Thus, it is vitally important that the plan **Project Outcomes** from each conservation measure in terms of what the measure is expected to contribute to the desired level of change in the hypothesized stressor. If a conservation measure does not produce the intended measurable effect, then it is assumed that the hypothesis is incorrect at some level. These Projected Outcomes are necessary in order to (a) assess, prior to plan adoption and implementation, the likelihood that the goal will be obtained and (b) after implementation, to determine whether desired changes in the ecosystem are being fully realized.

Again the ISAP report recognized the importance of projecting outcomes in order to discriminate between Conservation Measures that support their underlying hypotheses and those that do not. By projecting outcomes (both positive and negative), the consultants will also be able to clearly identify **Performance Metrics (ISAP Principle 5) and associated system-wide metrics** capable of demonstrating the intended effect of each conservation measure or hypothesis-desired change coupling within the description of that conservation measure or hypothesis-desired change. Although highly precise predictions and complete scientific study designs are not necessary at this point, the AMP should be clear regarding:

- how each conservation measure is expected to contribute to alleviating one or more hypothesized stressors
- which objectives/goals are served by addressing a given hypothesized stressor
- how effects will be measured and evaluated at the level of the conservation measures and the ecosystem as a whole
- whether impacts to different species or communities will require collection of different kinds of data
- when evaluation of results of conservation measure/objective implementation can be expected (when data sufficient to test the hypothesis/evaluate the conservation measure will be available)

By specifying how objectives will be achieved (the cumulative impact of relieving hypothesized stressors) and how desired levels of ecosystem change will be achieved (the cumulative impacts of conservation measures), decision-makers can evaluate the likelihood of plan success. By specifying how hypothesized stressors and conservation measures will be evaluated, decision-makers can understand the need for a data collection, management, and analysis "agent" (**ISAP Principle 7**) and when to consider modifications to the plan (e.g. implementing new or additional measures). Adaptive management is not the same as reactive management; decisions to modify plans should occur only with sufficient information to evaluate program success or failure. It is possible to estimate right now when there will be sufficient information to evaluate success of objectives and conservation measures.

Selection and Evaluation of Conservation Measures (ISAP Principles 2 and 4): Permitting changes to the Delta environment and legal protection afforded to covered species as proposed by BDCP necessitates a set of conservation measures with a demonstrable likelihood of success in contributing substantially to the recovery goal. There is much that is not known about this ecosystem, however, as the ISAP (2009) report notes, there is also much that *is* known about the Bay-Delta ecosystem and the BDCP process should begin its conservation regime with those actions that are likely to produce positive results rapidly.

Conservation Measures should be prioritized for implementation based on their "*physical and temporal scale, the degree of confidence in ... benefits, and the consequences of being wrong*" [ISAP p. 9]. Scale and consequences are related to a conservation measure's "reversibility". To be effective, the BDCP must implement those conservation measures that are (a) most likely (given current knowledge) to achieve plan objectives and (b) most easily reversed if the fundamental hypothesis linking the action to an objective is not supported or if the action has unintended consequences. Implementing actions that have a high certainty of benefit and low chance of causing permanent damage will allow the BDCP to provide covered species with near-term benefits while demonstrating the benefits (or shortcomings) of alternative conservation measures. For example, as noted above, the benefits of increased fresh water flow from the Delta during the spring to covered species, natural communities, and the estuarine ecosystem are well documented; they are also easily reversed.

The DRERIP process was designed to assess the likelihood of success and reversibility of different conservation actions. Unfortunately, that process was not completed to the point where proposed conservation measures were evaluated in this manner. We reiterate our recommendation (TBI August 2009 memo on the DRERIP process) to complete the DRERIP evaluation of proposed BDCP conservation measures.

We echo the ISAP (2009) report in strongly recommending that Conservation Measures be tied to conceptual models that identify *key stressors* that likely prevent attainment of recovery objectives – solving minor problems (or hypothetical problems) will do little to advance the Conservation Strategy's overall goals unless major limiting factors are addressed first (or simultaneously). Fortunately, many (though not all) of the conceptual models needed to identify key stressors in the ecosystem have already been developed as part of the DRERIP process. Unfortunately, there is no evidence that these models have been mined to identify the most pressing needs of covered species or ecosystem processes. For example, analysis of species life history conceptual models would reveal that physical habitat restoration actions in the Delta would not address many of the key stressors for endangered salmonids or longfin smelt.

As described above, the Conservation Strategy does not address the likelihood of success for conservation measures or identify the projected magnitude of their effect. The results of the DRERIP review process are hidden in an appendix to the Conservation Strategy. Rather than utilize information about key stressors that is available in the DRERIP conceptual models (in tables that were specifically designed to support the BDCP process) or information about likelihood of success and reversibility that could be derived from the DRERIP review process, the Conservation Strategy uses geography (location of actions) to assess the merits of proposed conservation measures. In this way, the Conservation Strategy avoids certain actions that could have significant benefits to covered species. For example, footnote number 2 on Table 3.1 refers to several elements of critical habitat stating "*this …element is present outside of the BDCP Planning Area and, therefore, is not addressed by BDCP biological goals and objectives*" [p. 23]. However, this supposed restriction has been violated in several of the Conservation Measures including actions dealing with Fremont Weir (outside the planning area according to the map on p. 55), salmon hatcheries (OSCM18), and the ocean fishery (OSCM 19). Rooting conservation measures in conceptual models that describe the knowledge-base regarding the fundamental causes of decline in species' populations or ecosystem function will allow the best strategic allocation of resources – we do not believe that viable conservation actions should be avoided because of geographical considerations.

Collection, management, analysis, and assimilation of data collected on species, natural communities, and ecosystems influenced by BDCP actions (ISAP Principles 7 & 8): To date, little or no attention has been given to how decisions will be made under an adaptive management framework once that framework is accepted and implemented. Clearly, metrics that relate to Conservation Measure implementation and efficacy as well as ecosystem response must be determined in advance of Conservation Strategy implementation. *That is the easy part.* The data will not manage themselves, or interface with other data sets, or provide credible analysis of relevant questions. Now is the time for the BDCP to identify, in addition to what information will be collected (and at what spatial and temporal intensity): What questions will be analyzed using this data? When will there be sufficient data to perform a valid analysis? Who will perform the analysis? Where will the data be warehoused? How will it interface with or incorporate other data sets? These are crucial decisions that will determine, in part, the success or failure of the "adaptive" part of Adaptive Management. Without a plan for data collection, management, and analysis, there is no hope that adaptive management will succeed.

The ISAP stated "*we strongly recommend that BDCP put considerable thought and investment into institutionalizing an entity that is specifically tasked with assimilating knowledge and recommending adaptive changes to goals, objectives, models, conservation measures, and monitoring... We consider this investment critical to the success of BDCP and to making adaptive management and integral part of this plan*" [p. 13]. We fully support this recommendation and fear that, if it is not implemented correctly, the entire BDCP Conservation Strategy will fail before any Conservation Measures are implemented. Adaptive Management cannot proceed without a well-articulated, well-planned, and appropriately-funded plan for analyzing results of Conservation Measures, presenting those analysis to decision-makers, and assimilating lessons learned.

The Draft Conservation Strategy also consistently confuses adaptive management with real-time modifications of operations, particularly for nearly all of the near-term and long-term water operations Conservation Measures (e.g., page 3-57, line 40; page 3-61, line16; etc.), where the "adaptive management considerations" sections describe modifications of specific operations in response to real-time monitoring for occurrence and/or distribution of eggs, larvae or fish, tidal stage, water elevation, or other ephemeral and episodic condition. Real-time operations may be of value, however, they should not be confused and cannot substitute for the incorporation of the broader, more comprehensive and longer-term adaptive management approach discussed above into the design and implementation of water operations under the BDCP.

<u>The Conservation Strategy should be based on a "logic chain" approach and prioritization criteria.</u>

In order to remedy the problems identified in this review and construct a legally and scientifically defensible Plan, Chapter 3 should be comprehensively revised based on the application of a "logic chain" approach, linking desired outcomes, hypotheses, projected outcomes, and performance assessment, and the prioritization of conservation measures according to scientific certainty, magnitude of potential ecological benefit, risk associated with incorrect implementation or underlying hypotheses, timeliness of projected outcomes, and information richness. The "logic chain" and prioritization criteria are described in greater detail below.

(It should be noted that while the logic chain was developed primarily using examples from the plan's aquatic covered species and habitats, its relevant key components are equally applicable to development of the conservation strategy for terrestrial species. For example, the terrestrial component should include "SMART" conservation objectives).

The logic chain approach, developed by TBI, American Rivers, and EDF, provides a scientifically rigorous framework for constructing a Conservation Strategy that flows logically from desired outcomes to a suite of Conservation Measures, to the metrics used to assess conservation measures and monitor progress toward objectives, to the analysis that will be required to evaluate the Strategy's success and necessary modifications:

1. Problem Statement: As the name implies, this is a broad, concise statement of the issues BDCP is trying to address for each species and the ecosystem as a whole. It implies the goals and should identify the general hypotheses regarding the main causes of the problem. It does *not* adopt one of the hypotheses as the "preferred" hypothesis.

2. Plan Goals and Objectives: Goals are ultimate outcomes regarding recovery of the ecosystem/covered species; these are statements that describe what is needed to achieve the recovery. Objectives are the answers to "we will know we have succeeded when _____". Objectives should be "S.M.A.R.T" – that is, specific, measurable, achievable, relevant (to the goal), and time-bound. Goals nor Objectives should neither specify how we get to the goal nor adopt a particular hypothesis about what prevents us from getting there. *Plan Goals and Objectives are not to be confused with specific BDCP permit terms and conditions*.

3. Conceptual Model: Conceptual models are detailed descriptions of how we believe the ecosystem or species populations function. Because of the complexity and high degree of uncertainty regarding how ecosystems function, conceptual models are generally built upon a web of hypotheses regarding the factors that drive and limit the ecosystems, key ecosystem processes, or particular species or habitats. Prioritization and scale of implementation rely on information in the Conceptual Models (e.g. the strength of support for various hypotheses). Various conceptual models are relevant to attaining any given Goal/Objective. As we learn more about the ecosystem through research and monitoring, we will update the conceptual model and in some cases, that may lead us to change or refine hypotheses and desired changes (targets) as described below.

4. Hypotheses: Conceptual models (*above*) contain numerous hypotheses. These hypotheses are *potential* explanations for what prevents the attainment of Goals and Objectives currently. Hypotheses identify *potential* stressors believed to limit progress toward the goal. Some hypotheses are exclusive and others may operate in tandem. But, because the operation of different stressors, not to mention their interactions with other stressors, is uncertain, it is valuable to disaggregate them. The adaptive management plan will implement Conservation Measures that should contribute to alleviating these potential stressors. But, these conservation measures must produce a level of change that actually begins to alleviate the stressor – this level is called the desired change.

5. Desired Changes: Desired changes (targets) are means of obtaining the objectives that rely on/test the veracity of different hypotheses. Like objectives, desired changes are S.M.A.R.T. Based on hypotheses, these outcomes are projected to reduce or eliminate a limit on attaining species, community, or ecosystem goals/objectives. Desired changes can be a combination of physical, biological, financial, or research outcomes (i.e. we may desire a change in the strength of our conceptual model or knowledge base). Like goals and objectives, desired changes can change as we revise the conceptual model, but only within the BDCP governance framework and pre-determine adaptive management range.

6. Conservation Measures: Conservation Measures are both restoration actions and tests of one or more hypotheses embedded in the conceptual models. If the hypothesis(es) that lead to "desired changes" and to "projected outcomes" are verified then the Conservation Measure will contribute to the Goal. ***Note**: Implementation of the Conservation Measure is neither a desired change, objective, or goal because the Conservation Measure's benefits are hypothetical – desired change, objectives, and goals are always outcomes; conservation measures are means to those ends.*

6a. Hypotheses re: Conservation Measures: The Conservation Measures are based upon conceptual models as well. These may be formal conceptual models (e.g. those produced by DRERIP) or internal conceptual models. Conservation Measures should state why they are expected to produce beneficial outcomes. We believe these can be written in the form of an equation (even a verbal equation would be quite valuable) that shows the contribution of different factors to the projected outcome. Thus, these "Conservation Measure-specific" hypotheses are used to develop projected outcomes.

7. Projected Outcomes: Conservation Measures are designed to achieve one or more outcomes. Clear articulation of how the conservation measure will produce Projected Outcomes (both positive and negative) allows decision-makers to understand how the Conservation Plan as a whole is expected to achieve its objectives and allows analysts and decision-makers to assess whether a Conservation Measure has contributed to its associated target(s). Identifying negative potential outcomes is critical to transparency and allows development of metrics to capture these potential impacts.

8. Actual (+ and -) Outcomes: Actions produce outcomes. We suspect some outcomes will be positive and some will be negative (detracting from attainment of the goal). We must measure both the positive and negative outcomes in order to understand if, on the whole, the conservation measure is successful (and to refine implementation of subsequent conservation measures).

9. Metrics: Metrics define environmental/biological/ecological variables that will be measured to determine whether (a) the conservation measure is contributing towards the objective/target (hypothesis 1) **AND** b) whether the objective/target is contributing towards attainment of the goal (hypothesis 2). Measuring only one of these two outcomes is not sufficient as we must know both that implementation of the Conservation Measure leads to the desired targets (e.g. that restored tidal marsh produces food and habitat) and that the targets actually contribute to the relevant goal/objective (e.g., more food results in more Chinook salmon).

10. Performance Evaluation: The translation of science into management cannot proceed unless results of monitoring and targeted studies ("metrics") are analyzed to determine effectiveness of conservation actions *and* the veracity of Conceptual Models (do desired changes contribute to attainment of Objectives) – these are two separate sets of hypothesis evaluation. The Independent Science Advisor's report (2009) stressed that this was missing from early drafts of the Conservation Strategy and it is still absent from the most recent version of Chapter 3.

Below, we identify and describe criteria that should be used to evaluate and prioritize potential Conservation Measures. We also identify those places in the adaptive management logic chain (or elsewhere) where relevant information regarding each conservation measure will be presented. (The order of presentation does not imply a hierarchy among these principles; *italics* indicate sources of information required to evaluate Conservation Measures based on these principles)

The following criteria should be used to evaluate and prioritize potential Conservation Measures:

Magnitude of Impact – All else being equal, Conservation Measures with potential for high magnitude positive effects are preferable to those with less potential for positive impacts. In the adaptive management logic chain, the anticipated magnitude of impact for each Conservation Measure will be identified under the heading "*projected outcomes*". Outcome projections will be based, to the fullest extent possible, on published research demonstrating the anticipated effect. The current *DRERIP review* (or similar) of Conservation Measures provides a readily available resource for projecting outcome magnitude and documenting the assumptions underlying the projection.

Breadth of Impact – Conservation Measures that benefit multiple species or ecosystem processes are of higher priority than those that serve only one species. When the adaptive management logic chain has been developed for each covered species, it will be a simple matter to identify the how many covered species/ecosystem processes each conservation measure is expected to benefit (i.e., this will be the sum of the number of times a given action occurs in the "*conservation measure*" section of the logic chain).

Certainty of Impact – Measures that are certain to produce their intended positive impacts are of higher priority than those where projected outcomes are uncertain. The DRERIP review process clearly identifies the level of scientific certainty associated with each potential outcome of each Conservation Measure. After the quality control and standardization steps TBI recommended previously have been completed, these ratings should be incorporated into the adaptive management logic chain under the heading "*projected outcomes*".

This principle does not imply that actions with high-uncertainty are never to be implemented; only that measures with a great deal of documented support are more likely to produce the conservation and water supply benefits that drive development of the BDCP. Implementing directed research or pilot project-scale measures that will demonstrate or falsify the assumptions underlying the measure can reduce uncertainty. The *DRERIP review process* includes specific mechanisms for determining whether measures are best implemented at full-scale or as pilot-projects or for targeted research; unfortunately, the DRERIP review was not completed to allow for this evaluation.

Consequences of Unintended Outcomes or Erroneous Hypothetical Basis for Action
Because of the complex nature of ecological systems, Conservation Measures are expected to have multiple outcomes – some positive, some negative. In addition, measures will interact in ways that produce unintended outcomes. Measures that may cause irreparable or significant negative outcomes are less desirable than those where the magnitude of potential negative outcomes is relatively low. As with anticipated positive outcomes, potential negative outcomes must be identified in the "*projected outcomes*" section of the logic chain, along with a description of their potential magnitude and certainty. The *DRERIP review* already described many of these potential negative outcomes; the documentation of such potential effects has already begun. We emphasize that it is important to identify potential negative outcomes as well as positive outcomes in the adaptive management framework because these allow: (a) realistic assessment of the overall value of an action and the plan as a whole and (b) design of metrics and analytical practices that will allow for the detection of such outcomes if they occur.

Reversibility – Measures that are easily reversible (in the physical, economic, and political sense) are preferred to those that are less reversible. This stems from the above discussion of certainty and potential negative outcomes (anticipated and unanticipated). If actions are judged to be counterproductive (either biologically or because they cost too much for their associated benefits), it will be desirable to undo them. The *DRERIP review process* calls for an explicit evaluation of a project's reversibility. This evaluation was either not performed or the findings have not yet been incorporated into the planning process.

Time Required to Demonstrate Outcomes – The conservation status of covered species and water supply reliability demand rapid attention. Therefore, actions that have the potential to produce positive outcomes rapidly are desirable. *Objectives* and *Desired Changes* identified in the adaptive management logic chain are time-bounded; only those projects that can produce relevant outcomes within the time-bounds of a given *Objective* can be counted as contributing to that *Objective*. Conservation Measures must be implemented before their actual outcomes can begin to materialize. Obviously, outcomes can only be demonstrated *after* they have occurred because it takes time to gather data and analyze patterns within the dataset.

The time required to demonstrate outcomes is the sum of the following periods:
1) Time to implement project
2) Time for expected outcome to develop

3) Time required to gather and analyze enough data to demonstrate the outcome (even preliminarily)

These three time components are specified in different places in the adaptive management logic chain. The time required to implement a project (#1) should be specified in the description of the project itself (i.e. under the heading *conservation measure*). The time required for an anticipated outcome to develop should be identified in the *projected outcomes* section of the adaptive management logic chain. If the time required for a projected outcome to develop does not match the time-bound for a *Desired Outcome*, it is inappropriate to include that measure under that target. Finally, the species/ecosystem process under consideration and metric used to measure the outcome influences the time required to gather data adequate for demonstrating an expected outcome. These considerations must be identified in the *analysis* section of the adaptive management logic chain; experts in ecological data collection and analysis should be consulted to provide a realistic estimate of the amount and type of data that will be needed to evaluate the magnitude of different outcomes and whether those outcomes have materialized at all.

We look forward to working with the Steering Committee and interested parties to correct the systemic problems we have identified and create a Conservation Plan that can serve as the basis for a legally and scientifically defensible HCP and NCCP.

Sincerely,

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Defenders of Wildlife

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